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Research Article

Development of Mucoadhesive Microsphere of Quinapril Hydrochloride for Treatment of Hypertension

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Abstract

Mucoadhesive drug delivery systems are very widely functional approach for delivery of system within the lumen of GIT to enhance drug absorption through the part of stomach with specific manner. Quinapril hydrochloride is the hydrochloride salt of quinapril, the ethyl ester of a non-sulfhydryl, angiotensin-converting enzyme (ACE) inhibitor, quinaprilat. The quinapril hydrochloride microspheres was prepared with a coat consisting of alginate polymer i.e. sodium alginate in combination of mucoadhesive polymer chitosan/ guargum by an ionic gelation process. The microspheres were evaluated for morphological character, particle size, micromeritic properties, percentage entrapment efficiency, in-vitro wash-off test and in-vitro release studies. The drug quinapril hydrochloride was study for the release over 24 h duration. The retarding nature of system maximizing the medication discharge rate at the appropriate site within specified time period for enhancing the bioavailability of drug at desired site of action to give successful treatment to the patients experiencing hypertension The drug release of the microspheres (QLMM1 – QLMM10) was slow, extended and dependent on the composition of galactomannan concentration of polymer and stirring speed during formulation used. The mucoadhesive microspheres were adhered at intestinal pH due to highly swelling nature of composition of polymers at this pH. So, increase the adhesive strength and retarded the drug release of best composition of CH:GG in the ratio of 1:3 (QLMM6). Guargum is a highly viscous material having a property of more swelling nature due to presence of galactommannan constituent. Thus, drug release from QLMM6 was slow and extended over a period of 24 h and these microcapsules were found suitable for oral controlled release formulations.

Keywords: Gastro-retentive drug delivery, Mucoadhesive microsphere, Quinapril hydrochloride, Pulsatile drug delivery system, Treatment of hypertension, Natural polymers

INTRODUCTION

Oral drug delivery systems face challenges such as low bioavailability due to the heterogeneity of the gastrointestinal system, pH of the commensally flora, gastric retention time of the dosage form, surface area, and enzymatic activity [1]. Drugs that are easily absorbed from the gastrointestinal tract (GIT) and have a short half-life are eliminated quickly from the blood circulation, so they require frequent dosing [2]. Conventional drug delivery systems may not overcome the issues imposed by the gastrointestinal tract (GIT) such as incomplete release of drugs, decrease in dose effectiveness, and frequent dose requirement. The advantage of these systems, such as prolonged gastric residence time of dosage forms in the stomach up to several hours, increased therapeutic efficacy of drugs by improving drug absorption, and prolonged gastric retention improves bioavailability, reduces drug waste, and improves solubility for drugs that are less soluble in a high pH environment [3]. In addition, Gastro retentive drug delivery systems can enhance the controlled delivery of drugs by continuously releasing the drug for an extended period at the desired rate and to the desired absorption site until the drug is completely released from the dosage form. Oral drug delivery is the ideal and well preferable route of administration due to its simple and comfortable use and flexibility about different types of formulation. Safety and convenient way of medication administration is achieved by oral route with highest patient compliance [4]. The conventional oral delivery systems show limited bioavailability because of fast gastric emptying time among many other reasons involved [5]. Controlled release, however, denotes that the system is able to provide some actual therapeutic control, whether this is of a temporal / spatial nature or both. By this the system attempts to control drug concentrations in target tissues for a controlled period of time. Sustained release dosage forms are designed to release a drug at a predetermined rate by maintaining a constant drug level for a specific period of time with minimum side effects [6]. The objective of the present investigation was to develop a gastroretentive drug delivery system(s) containing quinapril HCl as a drug candidate which would remain in the stomach or upper part of GIT for prolonged period of time thereby maximizing the drug release at the desired site within the stipulated time with a view to improve bioavailability. The Gastro-retentive Drug Delivery System(s) bearing antihypertensive (Quinapril Hydrochloride) drug for treatment of hypertension. In the present work three types of gastroretentive drug delivery systems as mucoadhesive microspheres using biodegradable polymers like Chitosan and Guar Gum etc. Quinapril HCl has short half-life of 2 hrs. So the gastro retentive drug delivery systems are needed for Quinapril HCl to prolong its duration of action, to increase its oral bioavailability, to reduce the frequency of administration and to improve patient compliance**.** Quinapril HCl is a prodrug

that belongs to the angiotensin-converting enzyme (ACE) inhibitor class of medications. Quinapril HCl is indicated for the treatment of high blood pressure (hypertension) and as adjunctive therapy in the management of heart failure.

MATERIAL AND METHODS

Analytical methods: The drug samples (Quinapril hydrochloride) use for determination of absorption maxima (λmax) in various solvents i.e. 0.1N HCl solution. The analytical method will be evaluated with preparation of calibration curve. The spectrum of these solutions was run in 200 – 400 nm range in double beam UV spectrophotometer (Shimadzu, UV-1800, A11454500755/UV-1800, Shimadzu Corporation, Kyoto, Japan). The calibration curves were prepared with concentration of drug solution of 5, 10, 15, 20, 25 µg/ml concentrations of Quinapril hydrochloride. These solutions were analyzed at 214 nm by double beam ultraviolet spectrophotometer.

Preformulation studies of drug sample: The drug samples will be studied for organoleptic properties, microscopic examination. The physical characteristics with density, particle size, Loss on drying, flow properties, compatibility, solubility in various dissolution medias, partition coefficient and drug-excipients compatibility study was done.

Preparation of mucoadhesive microspheres: Quinapril Hydrochloride microspheres were prepared by ionotropic gelation method. The required weighed quantity of polymers sodium alginate in combination with other polymers using chitosan and guargum in different ratios. Sodium alginate, chitosan and guargum was dissolved in slowly in deionized water employing mild heat (50°C) with by magnetic stirring to form a homogeneous polymer solution. The drug QHL was added to the resultant polymer solution to get a homogenous drug-polymer mixture and sonicated for 30 minutes. The dispersion was now added dropsies from #10 gauge hypodermic needle from a height of 6 cm into 100 ml aqeous 5 % solution of calcium chloride with desired various speed shown in **Table 1** for 1 h using mechanical stirrer. The gelled droplets microspheres were allowed to remain in calcium chloride solution for 30 minutes for complete curing, comoplete reaction for producing spherical regid microspheres, The microspheres were collected by decantation, seperated by filteration throgh whatman filter paper #44. The prepared product was washed repeatedly with deionized water to remove excess of CaCl2 that might have deposited on surface of microspheres. The microspheres were then dried at 50°C under vacuum asembly, dried and stored in dessicator for further study.

Table 1: Formulation of Various Batches of Mucoadhesive Microspheres of Quinapril Hydrochloride

S. No	Formulation Code	Polymer ratio	Chitosan (mg)	Guargum (mg)	Stirring speed (rpm)	Deionized wáter (ml)	Calcium chloride (% w/v)
1	QLMM1	01:01	50	50	250	100	5
2	QLMM2		50	50	500	100	5
3	QLMM3	01:02	50	100	250	100	5
4	QLMM4		50	100	500	100	5
5	QLMM5	01:03	50	150	250	100	5
6	QLMM6		50	150	500	100	5
7	QLMM7	02:01	100	50	250	100	5
8	QLMM8		100	50	500	100	5
9	QLMM9	03:01	150	50	250	100	5
10	QLMM10		150	50	500	100	5

Characterization of Mucoadhesive Microspheres

Particle size calculation: The particle size of Quinapril HCl loaded prepared mucoadhesive microspheres were examined by optical microscopic method. A pinch of prepared microspheres was dispersed in 5 mL of purified water. The dispersion was kept under sonication for about 5 mins. A small drop of resultant solution was further placed on a clean glass slide and diameters of particles were measured. Approximately 100 microspheres were counted for particle size determination using a calibrated optical microscope.

Shape and surface morphology of microspheres: The surface texture of drug-loaded mucoadhesive microspheres were studied using Scanning Electron Microscope (Jeol JSM-1600, Japan) at RGPV, Bhopal, India. The samples were dried thoroughly in vacuum desiccators before mounting on brass specimen studies. A small quantity of drug-loaded microspheres was spread manually on a carbon tape and gold alloy of 120Aº to an aluminum stub in Argon ambient of 8 – 10 Pascal with plasma voltage about 10mA for nearly 10 sec to obtain uniform coating on the sample to facilitate good quality of SEM images. Samples were analyzed by SEM with direct data capture of the image on a computer screen.

Flow properties of mucoadhesive microspheres: The various prepared mucoadhesive microspheres have been characterized with respect to flow properties as micromeritic properties. The bulk density of the powder was determined by adding the powder sample into a measuring cylinder.

The flow properties of prepared microspheres were characterized for identification of flow character of powder in terms of carr's index, hausner's ratio and angle of repose. The Carr's index ((IC)) and Hausner's ratio (HR) of drug powders were calculating according to following equation:

Carr's Index (IC) = ρTapped - ρBulk / ρTapped

Hausner's ratio (HR) = ρTapped / ρBulk

The angle of repose (θ) was measured by fixed height method. This was calculated by following equation:

Angle of repose (θ) = $\tan^{-1}$ 2 H / D

Where H is the surface area of the free standing height of the powder pile and D is diameter of pile that formed after powder flow from the glass funnel

Percentage entrapment efficiency: The prepared mucoadhesive microspheres were crushed in pestle mortar. The weighed of microspheres were equivalent of 30 mg of pure drug and crushed in pestle mortar. The in crushed microspheres were transferred into a 100 ml of volumetric flask containing 20 ml of ethanol with 80 ml of 0.1N HCl (SGF). The crushed mucoadhesive microspheres mixture was sonicated with ultra sonicator upto 1 h, and such mixture was filtered throughout with whatman filter paper (#44). The resultant solution was analyzed by UV spectrophotometrically at 214 nm. The percent drug entrapment was determined by following equation:

$$\text{Drug efficiency (\%)} \frac{\text{Amount of drug present in microspheres}}{\text{Theoretical amount of drug}} = 100$$

Percentage yield of microspheres: The prepared mucoadhesive microspheres were weighed after preparation and calculated by given formulae. The actual weight of obtained microspheres was divided by the total amount of all non-volatile material that was used for the preparation of the microspheres**.**

$$\text{\% Yield} \frac{Actual\ weight\ of\ product}{Total\ weight\ of\ excipients\ \&\ drug} = 100$$

Swelling Index: The swelling characteristics of mucoadhesive microspheres were estimated in the SGF medium 0.1 N HCl (pH 1.2). The prepared mucoadhesive microspheres equivalent of 30 mg of drug from different batches were placed in the dissolution medium (0.1 N HCl pH 1.2) for 24 hours. The microspheres were allowed to swollen upto 24 h and swollen microsphere weight or mass was found out by first blotting the microsphere with filter paper to eradicate. The percentage of swelling of microspheres in the dissolution media was then calculated by the formula contained in equation**.**

$$Swelling\ Index\ (Sw) = \frac{Wt - W0}{W0} = 100$$

where, Sw=Percentage of swelling microsphere, W_t=Weight of microsphere at time 't' and W_o=Initial weight of the microspheres.

In-vitro wash-off test: Freshly excised pieces of intestinal mucosa (5 x 2 cm) from sheep were mounted onto glass slides (3 x 1 inch) with adhesive material. About 100 number of microspheres were spread onto each wet rinsed tissue specimen, and immediately thereafter the support was hung onto the arm of a USP tablet disintegrating test apparatus. The disintegrating test machine was operated with tissue specimen, cylinder was regular moved up and down in the test fluid at 37ºC. At each one hour time intervals up to 12 h regularly check machine, after completion of experiment the machine was stopped and the number of microspheres still adhering to the tissue was counted**.**

$$\text{\% mucoadhesion} = \frac{\text{No. of Mucoadhesive adhered}}{\text{No. of Microspheres applied}} = 100$$

In-vitro drug release: The in vitro dissolution studies of prepared mucoadhesive microspheres (equivalent to 30 mg drug) were performed by using the USP type II dissolution testing apparatus for 24 h. The dissolution medium used for the study was 900 mL 0.1N HCL; temperature 37 ± 0.5°C with stirring speed at 100 rpm to maintaining the sink conditions..

At predetermined time intervals 1 ml of samples were withdrawn periodically, which replaced with pre-warmed fresh medium. The samples was diluted with dilution medium, passed through a membrane filter (#5 mm), and analyzed spectrophotometrically using a UV spectrophotometer (Shimadzu UV-1800, Japan) at 214 nm with triplicate study and average data were considered for the analysis**.**

Drug Release Kinetic Data Analysis: Several kinetic models have been proposed to describe the release characteristics of a drug from matrix. The following three equations are commonly used, because of their simplicity and applicability. Equation 1, the zero-order model equation (Plotted as cumulative percentage of drug released vs time); Equation 2, Higuchi's square-root equation (Plotted as cumulative percentage of drug released vs square root of time); and Equation 3, the Korsmeyer-Peppa's equation (Plotted as Log cumulative percentage of drug released vs Log time).

RESULTS AND DISCUSSION

Quinapril hydrochloride was identified using different methods viz. melting point determination, determination of absorption maxima (λmax), loss on drying, and FTIR spectroscopy. The physical appearance of the Quinapril Hydrochloride was found as a white powder. Absorption maxima (λ_{max}) of Quinapril hydrochloride was found to be at wavelength 214 nm corresponding to the values reported in literature (214 nm). A calibration curve of Quinapril hydrochloride was prepared in 0.1N HCl pH 1.2 and data was subjected to linear regression analysis. The linearity was found to be obeyed in the concentration range of 5-25 µg/ml in the media, r-values were found to be 0.998 in 0.1N and followed Beer and Lambert's law **(Figure 1 and Table 2)**. The physical nature of drug was White powder, odourless and bitter taste in nature. Melting point of Quinapril hydrochloride was found to be 124^{0}C, which comes under the range (120-130^{0}C) as given in reference. The loss on drying for drug was found to be 0.5% (limit 1.0 %). The solubility of Quinapril hydrochloride was determined in different media. The drug was found to be freely soluble in both the selected media. The solubility of the drug in 0.1N HCl and water was found to be 0.0276 and 0.0094 mg/ml in different solvent respectively. FTIR spectra showed that the drug is compatible with all the excipeints studied as no changes in the peaks were noted. FTIR spectrum of the quinapril hydrochloride was indicated that the characteristics peaks belonging to measure functional groups such as principal peaks at wave numbers 1590.2357 cm^{-1} (N-H bend, primary amine), 1645.2547 cm^{-1} (C=C stretching Alkenyl), 1700.0600 cm^{-1} ((-C=O Carbonyl), 1355.2152 cm^{-1} (C-N stretching, aromatic tertiary amine), 750 cm^{-1} (C-Cl stretching Aliphatic Chloro Compound) and 650.2569cm^{-1} (C-H bend, alkynes) respectively. This study confirmed that the test sample was of Quinapril hydrochloride. The observed peak of drug polymer complexes were 2899 (C-H stretching (Methylene), 1658 (C=C stretching (Alkenyl), 1423 (C-H bending (Methyl), 886 (C-H bending), 751 (C-Cl stretching (Aliphatic Chloro Compound). The result of FTIR drug complex study was confirmed that, there was no interference between both materials. The formulation has no interaction **(Figure 2-3)**.

The prepared mucoadhesive microspheres were characterized by various parameters i.e. particle size calculation, shape and surface morphology, micromeritic properties, percentage entrapment efficiency, swelling index, in-vitro wash-off test, in vitro dissolution studies and in vivo mucoadhesion behaviour. The mucoadhesive microspheres were found to be discrete, spherical and free-flowing. The effects of chitosan concentrations and polymer ratios on the average particle size and % drug entrapment of microspheres were studied. The mean particle size increased with increase in polymer

concentration which might be due to the fact that as polymer concentration increases it produces a significant increase in the viscosity, leading to an increase of the emulsion droplet size and finally a higher microsphere size. The percent entrapment efficiency for the different formulations significantly increased with increasing polymer content ($p<0.05$). The mucoadhesive microspheres (QLMM6) with CH:GG in 1:3 ratio produced the highest percent drug entrapment efficiency of 93.73±1.44%. An increase in polymer concentration resulted in formation of larger microspheres entrapping greater amount of drug with médium stirring speed at 500 rpm. The SEM of prepared microspheres (QLMM6) showed formation of cracks on the surface of the microspheres was observed. Thus was due to the penetration of the dissolution medium into the microspheres and the subsequent dissolution of the drug and hence its diffusion through the polymer matrix. The physical study parameters like angle of repose, tapped density, bulk density and packing properties **(Table 4)** confirms better good to excellent flow properties of the prepared microspheres. The drug entrapment percentage was found to be ranging from 86.18±.74 to 93.73±1.44. The result of drug loading is reduced due to formation of smaller microspheres, which occurred due to increased drug loss from their surface while washing during the collection process. The percentage yield also increases with increase polymer concentration. It was also observed that the percentage yield was significance increases with the increasing stirring speed. The swelling index of mucoadhesive microspheres was found to be in the range of 1.08±0.62 to 1.93±0.94. Swelling studies showed that the amount of polymer plays an important role in solvent transfer. It can be concluded that an increasing in polymer concentration, the swelling index also increased. The mucoadhesion test was performed on both simulated gastric pH (0.1N HCl, pH 1.2) for 24h. The microspheres were adhered at intestinal pH due to highly swelling nature of composition of polymers at this pH. So, increase the adhesive strength and retarded the drug release of best composition of CH:GG in the ratio of 1:3 (QLMM6). Guargum is a highly viscous material having a property of more swelling nature due to presence of galactommannan constituent. Thus, poor mucoadhesion of QLMM1 formulation was shown due to having reducing amount of guargum. Although chitosan was also playing the important role on the mucoadhesionas hydrophilic functional groups presence in polymer. Thus, the microspheres having specific ratio of chitosan could form hydrogen bonds with mucus molecules, thus producing some adhesive force of this polymer **(Table 5)**. The in-vitro of drug showed maximum absorption expected with increasing solubility in acid environment. It is known that microspheres constitute multipleunit dosage forms which have many advantages as compared to tablets. They spread more evenly in the stomach which leads to a decreased risk of high local concentration at the specific site for better effect. The in-vitro release studies were carried out in 0.1 N HCl (pH 1.2), which indicated that there was a slow and controlled release of drug for all the formulations. The drug release of the microspheres (QLMM1 – QLMM10) was slow, extended and dependent on the composition of galactomannan concentration of polymer and stirring speed during formulation used. The differences in the drug release characteristics of various microspheres might be due to the differences in the porosity of the coat formed and swelling and adhesión nature of coat and its solubility in the dissolution fluid. Drug release from QLMM6 was slow and extended over a period of 24 h and these microcapsules were found suitable for oral controlled release formulations. Among the ten formulations (QLMM1 to QLMM10) prepared, formulations QLMM6 was found to be the best formulations in terms of drug release **(Table 6 and Figure 5-8)**. The results of the release kinetics study showed that all the formulations obeyed first order drug release profile more closely, i.e., the release rate depended upon the initial concentration of drug. The slope values of the Korsmeyer-Peppas plot showed that the mechanism was non-fickian or supercase II transport mechanism.

Table 2: Calibration curve of Quinapril hydrochloride in 0.1 N HCl (pH 1.2)

S. No.	Concentration (µg / ml)	Absorbance
1	0	0
2	10	0.246
3	15	0.372
4	20	0.482
5	25	0.615

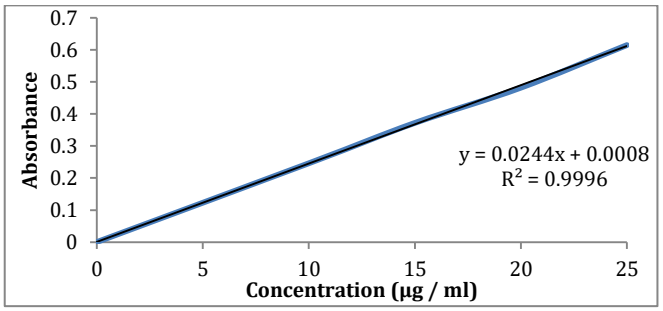

Figure 1: Calibration Curve of Quinapril hydrochloride in 0.1 N HCl (pH 1.2)

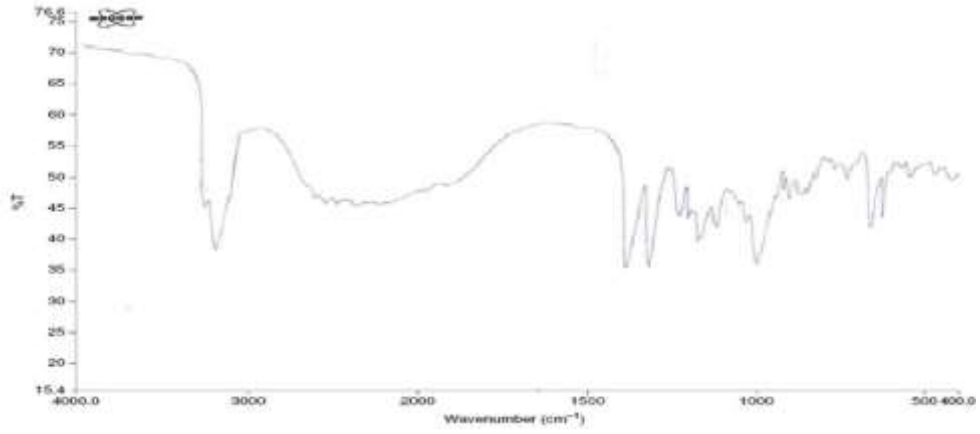

Figure 2: FTIR Spectrum of Quinapril Hydrochloride

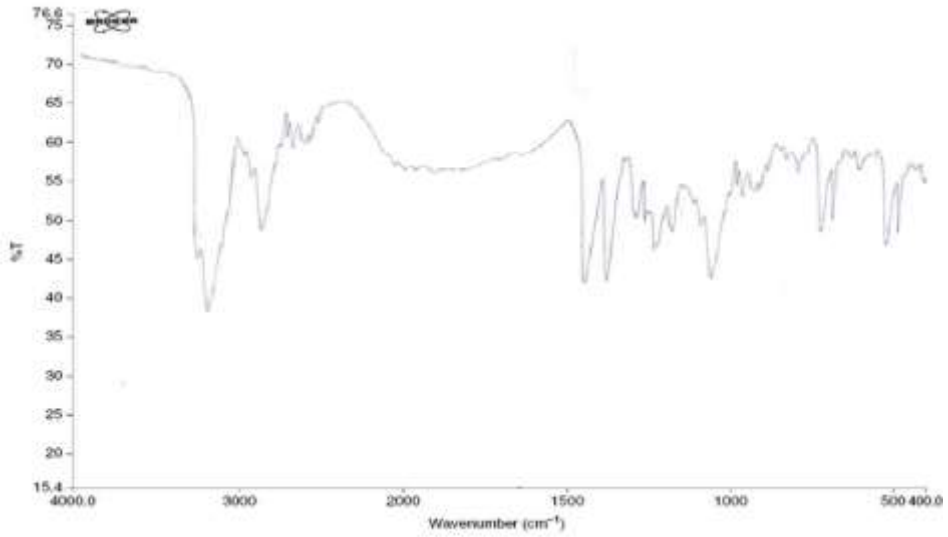

Figure 3: FTIR Spectra of physical mixture of Quinapril HCl and All polymers

Table 4: Particle size of mucoadhesive microspheres (QLMM1 - QLMM10)

Formulation code	Bulk density[a] (g/cm³)	Tapped density[a] (g/cm³)	Carr's index[a] (%)	Angle of repose[a] (h°)
QLMM1	0.42±0.011	0.47± 0.012	10.63±0.13	24.25±1.23°
QLMM2	0.36±0.028	0.42±0.007	14.28± 0.25	25.22±1.16°
QLMM3	0.41±0.028	0.46± 0.026	10.86±0.95	22.16±1.67°
QLMM4	0.40±0.017	0.45±0.012	11.11±0.97	24.91±1.20°
QLMM5	0.38±0.015	0.44± 0.018	13.63±0.85	22.98±1.01°
QLMM6	0.36±0.028	0.42±0.007	14.28± 0.25	25.22±1.16°
QLMM7	0.43±0.011	0.49±0.021	12.24± 0.18	23.25±1.02°
QLMM8	0.36±0.028	0.42±0.007	14.28± 0.25	25.22±1.16°
QLMM9	0.43± 0.017	0.49± 0.021	12.24±0.18	22.22±1.22°
QLMM10	0.39±0.023	0.45± 0.011	13.33±1.18	25.91±1.17°

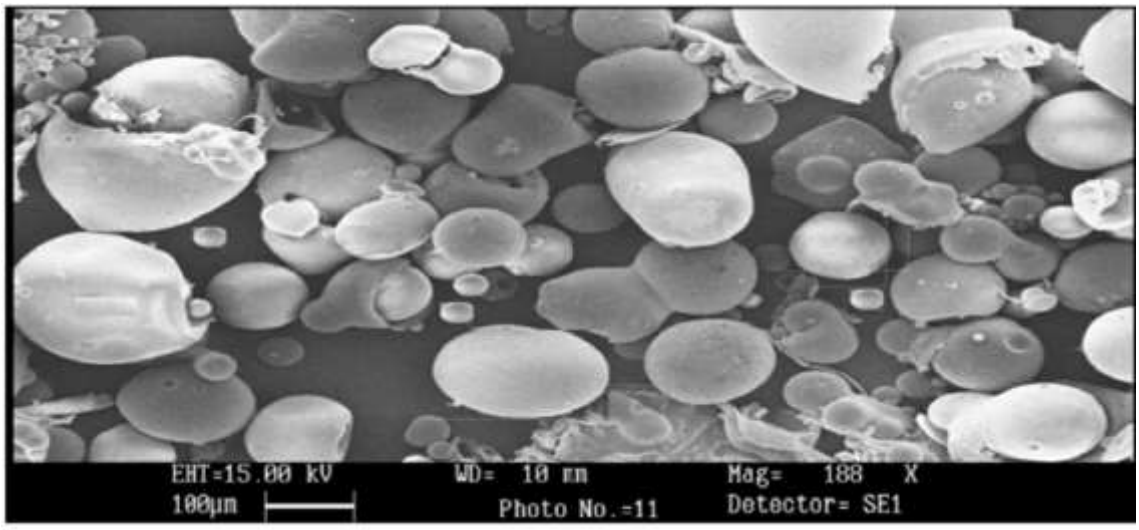

Figure 4: SEM image of the optimized mucoadhesive microsphere formulation, (QLMM)

Table 5: Characterization of mucoadhesive microspheres (QLMM1 - QLMM10)

Formulation code	Mean particle size[b] (µm)	Percent entrapment	Percentage yield	Swelling index	Percent mucoadhesion
QLMM1	261.26±2.35	86.18±.74	90.22±1.78	1.08 ±0.62	81.18±3.04
QLMM2	240.12±3.18	87.17±1.05	92.17±1.96	1.64 ±0.32	83.21±2.89
QLMM3	266.28±3.38	88.05±1.14	94.11±2.01	1.38 ±0.21	73.25±2.11
QLMM4	249.01±2.05	90.11±2.04	92.15±1.88	1.79 ±0.55	91.06±2.43
QLMM5	272.11±2.15	90.14±1.14	91.96±1.96	1.32 ±0.25	81.25 ±0.43
QLMM6	259.08±2.11	93.73±1.44	97.12±1.63	1.93 ±0.94	94.12±2.85
QLMM7	282.22±2.22	88.81±1.09	95.25±2.01	1.24 ±0.44	81.08 ±0.62
QLMM8	245.13±2.65	91.09±1.46	96.17±1.98	1.76 ±0.62	80.09±2.89
QLMM9	288.12±3.25	87.14±1.12	98.97±1.63	1.15±0.45	79.06±1.85
QLMM10	251.16±3.16	88.9±2.01	95.15±1.99	1.56 ±0.11	76.81±2.16

Table 6: Dissolution data of mucoadhesive microspheres (QLMM1 - QLMM10)

Time	QLMM1	QLMM2	QLMM3	QLMM4	QLMM5	QLMM6	QLMM7	QLMM8	QLMM9	QLMM10
0	0	0	0	0	0	0	0	0	0	0
2	2.54	4.77	3.01	3.71	4.18	0.571	4.68	1.23	4.71	0.781
4	7.43	12.23	9.11	11.21	8.12	1.76	10.12	3.39	13.21	3.45
6	11.23	20.31	13.67	15.68	17.34	5.67	18.34	3.39	18.68	7.46
8	21.87	29.22	24.78	31.67	25.45	12.34	27.45	14.5	35.67	13.23
10	33.25	41.54	31.24	41.27	36.54	25.67	38.54	21.34	45.27	26.56
12	48.78	51.65	41.28	49.25	45.65	36.45	47.65	37.56	53.25	38.34
14	55.34	60.67	49.68	62.34	57.67	46.78	59.67	58.45	66.34	48.34
16	68.21	78.6	65.76	71.54	73.6	59.04	75.6	71.23	76.54	58.34
18	72.45	79.14	71.54	72.21	76.14	62.21	78.14	78.41	79.21	64.74
20	76.34	85.34	74.32	84.74	82.34	69.34	84.34	82.46	88.74	69.87
22	81.65	89.11	79.54	88.74	85.87	72.18	87.87	85.41	91.74	78.74
24	88.13	92.23	85.65	90.37	90.13	79.67	91.23	89.6	95.37	81.26

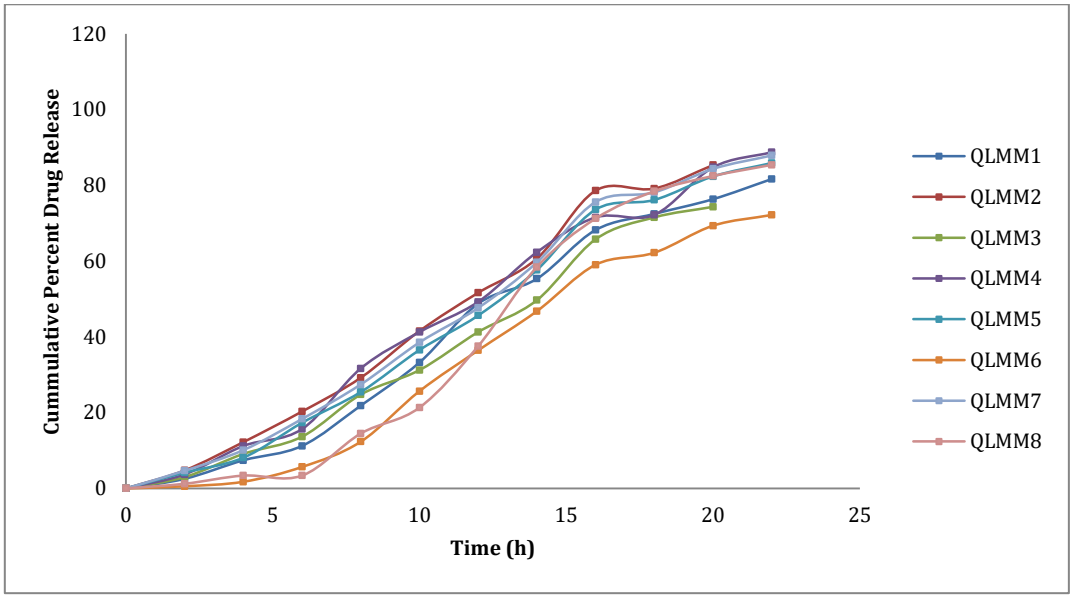

Figure 5: Zero-order plots of mucoadhesive microspheres (QLMM1 - QLMM10)

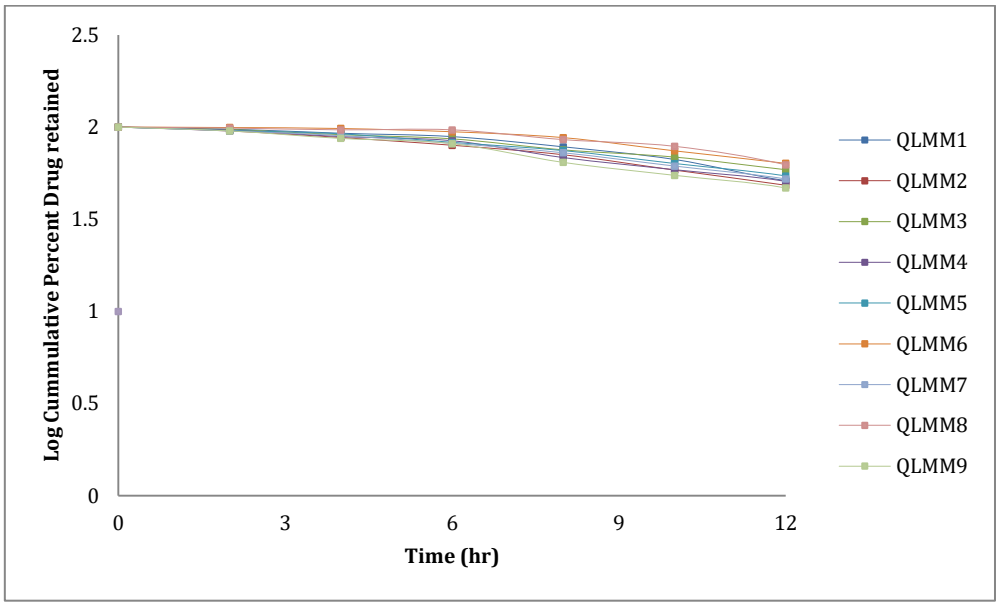

Figure 6: First-order plots of mucoadhesive microspheres (QLMM1 - QLMM10)

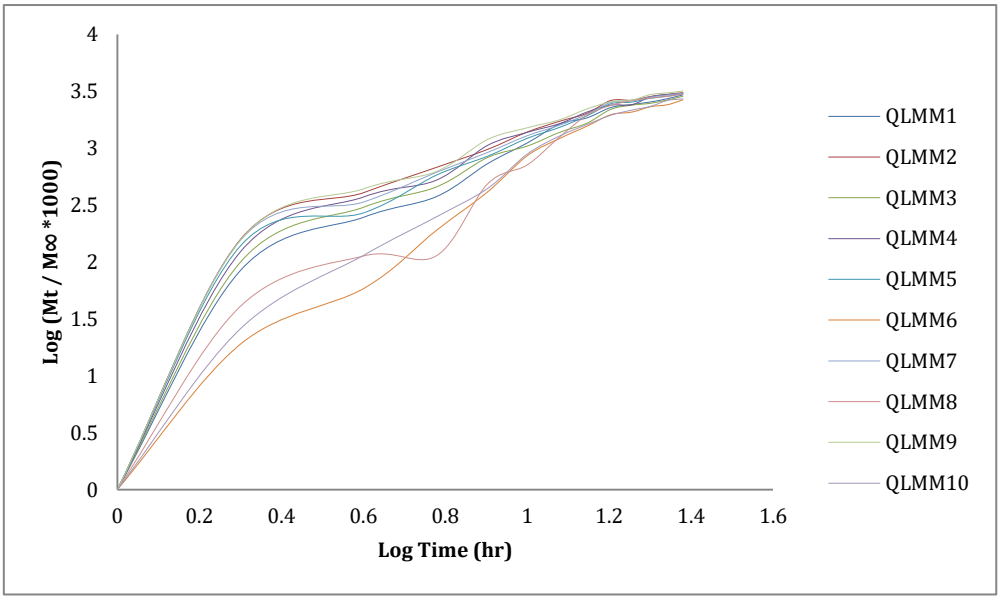

Figure 7: Korsmeyeyr's Peppas plots of mucoadhesive microspheres (QLMM1 - QLMM10)

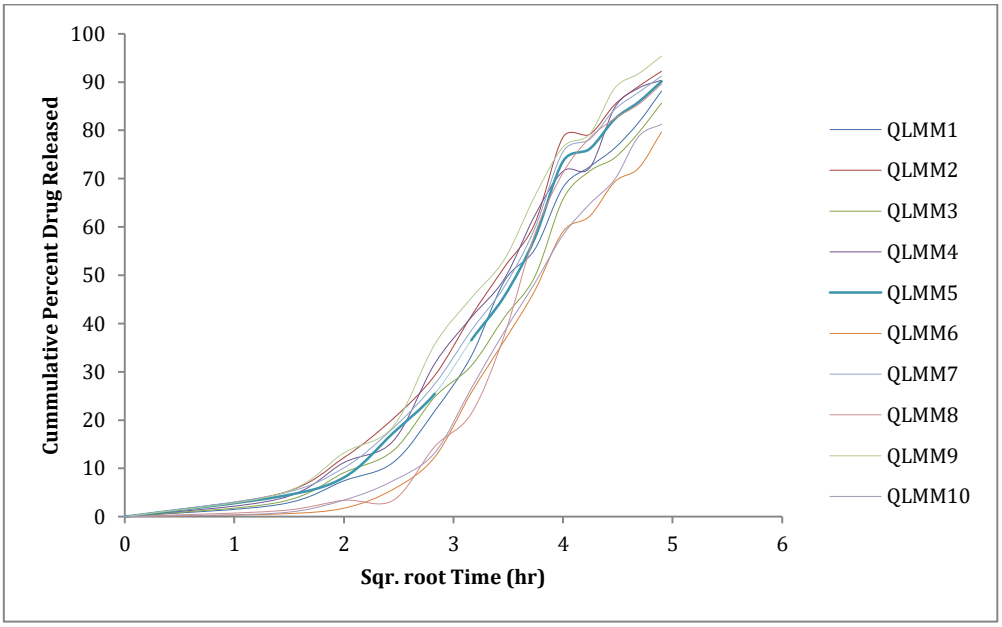

Figure 8: Higuchi plots of mucoadhesive microspheres (QLMM1 - QLMM10)

SUMMARY AND CONCLUSION

The oral course of medication organization is considered as most brilliant way because of keep drug meditation inside the remedial window, patient observance, simplicity of administration, however simultaneously face difficulties such huge fluctuation in the medication level, low bioavailability, gastric retention instance of the formulation, surface region, and enzymatic movement. The mucoadhesive microspheres prepared by ionotropic gelation technique able to sustained drug release up to more duration. Microspheres expected to best reproducible results and can prove to be promising carrier for oral delivery of Quinapril Hydrochlorideand thereby help in the management of hypertension with oral route. The prepared mucoadhesive microspheres were characterized by various parameters i.e. particle size calculation, shape and surface morphology, micromeritic properties, percentage entrapment efficiency, swelling index, in-vitro wash-off test, in vitro dissolution studies and in vivo mucoadhesion behaviour. The drug release of the microspheres (QLMM1 – QLMM10) was slow, extended and dependent on the composition of galactomannan concentration of polymer and stirring speed during formulation used. The results of the release kinetics study showed that all the formulations obeyed first order drug release profile more closely, i.e., the release rate depended upon the initial concentration of drug. The slope values of the Korsmeyer-Peppas plot showed that the mechanism was non-fickian or supercase II transport mechanism. The mucoadhesive microspheres were adhered at intestinal pH due to highly swelling nature of composition of polymers at this pH. So, increase the adhesive strength and retarded the drug release of best composition of CH:GG in the ratio of 1:3 (QLMM6). Guargum is a highly viscous material having a property of more swelling nature due to presence of galactommannan constituent. Thus, drug release from QLMM6 was slow and extended over a period of 24 h and these microcapsules were found suitable for oral controlled release formulations.

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